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Control of Cotton Wilt and "Rust"

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CONTROL OF COTTON WILT AND "RUST"

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The work reported in this bulletin is a continuation and amplification of work previously reported *(2, 3, 4,)*[1] and gives the results of studies designed to secure practical control measures for the wilt of cotton caused by *(Fusarium vasinfectum)* (Atk.) and "rust", or potash hunger.

In 1929 *(loc. cit.)* the authors made a preliminary report on the results of studies of wilt resistant varieties of cotton at Galloway, Arkansas, and at the Cotton Branch Experiment Station in Lee County, Arkansas. It was found that even when root-knot, caused by *Heterodera radicicola*, is a factor, certain varieties of cotton still possess a considerable amount of resistance to the cotton wilt disease. Recommendations were made involving the discarding of certain older wilt-resistant varieties because of their unsuitability to Arkansas conditions. Tentative recommendations were also made regarding the use of other wilt-resistant varieties.

Greenhouse studies with organic fertilizers in the form of green manures indicated that under the conditions of the experiment they were ineffective for cotton wilt control. When soils fertilized with green manures and inoculated with pure cultures of *Fusarium vasinfectum* were analyzed for nitrite nitrogen, it was found that nitrites may be present in greater amounts than when soils are fertilized with an inorganic nitrate fertilizer. Ammonia and nitrate determinations of soil fertilized with organic and inorganic nitrogen showed no correlation between the amount of cotton wilt present and their ammonia or nitrate content. When grown in a solution using inorganic salts as a source of nitrogen, *Fusarium vasinfectum* was not found to function as a reducing agent.

Studies covering field work at the Cotton Branch Experiment Station during the years 1927 to 1930 inclusive *(2)* dealt largely with the behavior of a considerable number of wilt resistant and wilt susceptible varieties of cotton on land uniformly inoculated with the cotton wilt fungus. Tests were made of the various agronomic qualities of these varieties such as staple length, lint index, percentage of lint, earliness, boll size, size of seed, number of seed per lock, and yielding qualities. An attempt was made to correlate these various qualities with wilt resistance or susceptibility. It was found that, while certain extremely early varieties of cotton are very susceptible to cotton wilt and that certain late varieties

[1]George Janssen, one of the authors of previous numbers, died Jan. 31, 1932

are highly wilt resistant, no definite correlation involving any of these characteristics and susceptibility or resistance to the cotton wilt disease could be traced. Likewise, wilt resistance was not found to be correlated with shortness of lint or smallness of bolls. The results indicated that there were long, medium, and short-linted varieties of wilt resistant cotton, sufficiently early and sufficiently productive for use in localities where cotton wilt was severe or moderately severe, and that among those varieties were to be found desirable ones for use in all parts of Arkansas where cotton wilt is prevalent.

Further work at the Cotton Branch Experiment Station and at twelve other points in central, eastern and northeastern Arkansas *(4)* dealt with the relation of fertilizers to cotton wilt and "rust," or potash hunger. It was shown that cotton wilt, "rust," or potash hunger, and in many cases root knot or nematode disease, are often associated in a disease complex which is likely to result in severe damage to cotton. Much of the sandy alluvial soil of the larger river valleys of Arkansas is characterized by low-potash content especially when such soil has been cropped to cotton for many years, and under such conditions "rust" and cotton wilt often appear in an aggravated form. It was found that under such conditions high-potash applications alone and fairly high-potash applications in combination with nitrogen and phosphorus-containing salts gave definite control of both "rust", or potash hunger, and cotton wilt. High amounts of nitrate, applications containing nitrogen and phosphorus only, and applications of cottonseed meal alone were inefficient in cotton wilt control. The control of cotton wilt through the use of potash-containing fertilizers seemed in nearly all of the tests to be correlated with or coincident to the control of "rust", stimulation of vegetative growth and increased yields of seed cotton. In one case root knot, or nematode disease, was present and the effects of potash fertilizers on the incidence of cotton wilt were largely counteracted by the increased susceptibility of the plants to attacks of the cotton wilt fungus resulting from the nematode injury.

The work included in the present report gives the results of further studies of old and new wilt-resistant and wilt-susceptible varieties of cotton, including a comparison of their more important agronomic qualities, and further tests of the relation of fertilizers to the control of cotton wilt and "rust", or potash hunger. An attempt is also made to correlate the use of wilt-resistant varieties with the use of potash fertilizers to secure a well rounded program of control for cotton wilt and "rust."

For the sake of convenience the various phases of the work are reported separately.

Studies of Varietal Resistance to Cotton Wilt

The data on wilt resistance are for the period 1931-1933, inclusive, the same land at the Cotton Branch Experiment Station being used as was employed for previous work *(2, 3)*. Since the methods of study used have been described in detail *(3)* only a very brief description of experimental methods is included here.

Experimental results, 1931. As in previous years, each variety was planted in three series of single row plots, the three plots of each variety equaling very nearly one-eighteenth of an acre. In each of the three series every fifth row was planted to Trice 304, a wilt susceptible variety which has been used as a check since the beginning of the work at the Cotton Branch Station. Soil was inoculated as with the former studies by means of a composite inoculum made by mixing cultures on wheat bran of four separate strains of *Fusarium vasinfectum* known from previous work to be pathogenic to cotton. The inoculum was placed under the seed bed several days prior to planting. Land was fertilized with 250 pounds of nitrate of soda per acre placed in the bed on April 11, 1931, and the seed planted May 13, 1931. After determining the number of plants present on June 30, counts of plants affected with the cotton wilt disease were made every 10 days until September 7, when the final count was made. Plants which were so severely

Table 1. Development of Cotton Wilt Showing Percentage of Plants Wilted at Several Dates in Wilt-Resistant and Wilt-Susceptible Varieties in Artificially Inoculated Land, the Three Series Averaged, 1931

Order planted and row number	Variety name and strain number	Percentage of Wilted Plants						
		June 30	July 10	July 20	Aug. 1	Aug. 11	Aug. 20	Sept. 7
1 ck	Trice 304	.7	3.6	4.9	7.8	9.3	10.3	12.3
2	Arkansas 17	.2	1.0	1.4	2.0	2.7	2.9	3.1
3	Express 317	.5	1.1	1.2	1.6	1.7	1.7	1.9
4	Missdel 2	.3	2.8	4.2	7.1	10.0	13.2	17.7
5	Delfos 668	.8	2.8	4.4	6.2	7.4	9.2	10.2
6 ck		.7	3.0	6.9	7.4	9.0	10.9	13.2
7	Super Seven 5	.0	0.3	0.5	0.6	0.6	0.6	0.7
8	D. and P. L. 6	.1	0.4	0.8	1.4	1.6	1.7	1.8
9	Dixie-Triumph (La.)	.2	0.7	1.4	1.8	1.9	1.9	1.9
10	Dixie-Triumph (Watson)	.2	0.5	0.6	0.6	0.7	0.7	0.7
11 ck		.4	2.9	4.2	6.3	8.4	10.1	12.0
12	Half and Half	.3	1.8	2.7	5.0	6.3	7.0	7.7
13	Arkansas Rowden 40	.2	0.9	1.5	2.0	2.3	2.5	2.7
14	Wilson Type Big Boll	.5	2.4	3.4	4.3	4.7	5.0	5.0
15	D. and P. L. 10	.4	3.0	4.3	6.4	8.0	9.6	11.6
16 ck		.5	3.1	4.2	7.3	9.3	10.9	12.5
17	Cleveland 54	.2	1.8	3.0	3.9	4.1	4.3	4.5
18	Arkansas Rowden 2088	.2	0.9	1.4	1.6	1.7	1.7	1.9
19	Wilt Cleveland 29-1	.3	3.1	6.4	7.1	8.3	8.8	9.9
20	Arkansas Acala 34	.4	2.8	4.0	6.4	8.1	8.5	8.8
21 ck		.7	3.0	4.3	6.7	8.4	9.7	11.5
22	Dixie 14	.1	0.4	0.7	0.9	1.0	1.1	1.2
23	Miller	.1	0.5	0.8	1.0	1.2	1.2	1.3
24	Arkansas Rowden 2119	.04	1.1	2.0	2.7	3.5	4.0	4.2
25	Arkansas Rowden 4053	.3	1.8	2.9	3.6	4.5	4.9	5.3
26 ck		.5	3.7	5.5	8.3	10.5	12.1	14.3

TABLE 2. FINAL PERCENTAGE OF PLANTS WILTED COMPARED WITH EARLINESS, SEED COTTON YIELD, LINT PERCENTAGE, LINT YIELD, STAPLE LENGTH, SIZE OF BOLLS, CROP VALUE AND RELATIVE EASE OF PICKING, THREE SERIES AVERAGED, 1931

Order planted and row number	Variety name and strain number[1]	Total plants wilted	Earliness[2]	Acre yield of seed cotton	Lint	Acre yield of lint	Lint yield difference from ck	Staple length	Bolls to the pound[3]	Acre value of seed and lint	Time required to pick a bale
		Per cent	*Per cent*	*Pounds*	*Per cent*	*Pounds*	*Pounds*	*32nds*	*Number*	*Dollars*	*Days*
1 ck	Trice 304	12.3	35.8	1384	31.7	439		31	83.3	30.50	8.77
2	Arkansas 17	3.1	21.3	1188	29.9	355	— 83	35	74.6	28.01	8.33
3	Express 317	1.9	16.7	1169	29.5	345	— 91	35	77.5	27.27	8.77
4	Missdel 2	17.7	22.7	1119	30.6	342	— 93	36	92.6	28.68	10.10
5	Delfos 668	10.2	24.5	1400	28.5	398	— 35	36	74.6	33.87	8.77
6 ck		13.2	33.8	1375	31.4	432		32	82.6	30.64	8.77
7	Super Seven 5	.7	9.1	1268	31.4	398	— 26	35	82.6	31.06	8.77
8	D. and P. L. 6	1.8	21.3	1056	32.5	343	— 72	36	83.3	28.43	8.55
9	Dixie-Triumph (La.)	1.9	16.4	1499	30.5	457	+ 50	31	70.9	32.04	7.75
10	Dixie-Triumph (Watson)	.7	10.7	1181	29.5	348	— 50	34	77.5	26.65	8.77
11 ck		12.0	34.0	1212	32.2	390		30	84.7	26.50	8.77
12	Half and Half	7.7	20.4	1238	37.0	458	+ 57	30	74.1	30.19	6.67
13	Arkansas Rowden 40	2.7	29.1	936	31.6	296	—117	33	63.3	21.67	6.67
14	Wilson Type Big Boll	5.0	28.6	1514	31.6	478	+ 54	30	75.2	32.62	7.94
15	D. and P. L. 10	11.6	28.6	1299	33.3	433	+ 3	33	85.5	31.34	8.55
16 ck		12.5	35.1	1409	31.7	447		32	83.3	31.63	8.77
17	Cleveland 54	4.5	23.9	1365	31.5	430	— 15	32	68.5	30.48	7.25
18	Arkansas Rowden 2088	1.9	24.9	1016	31.1	316	—126	32	59.9	22.46	6.41
19	Clevewilt 29-1	9.9	16.5	1114	32.0	357	— 83	33	78.1	26.06	8.13
20	Arkansas Acala 34	8.8	24.9	1144	32.8	375	— 62	33	76.3	27.25	7.75
21 ck		11.5	34.9	1399	31.1	435		31	82.0	30.35	8.77
22	Dixie 14	1.2	12.6	1099	30.9	340	—102	32	74.6	24.19	8.13
23	Miller	1.3	28.5	984	30.7	302	—149	33	61.3	22.25	6.67
24	Arkansas Rowden 2119	4.2	28.5	1008	32.1	324	—135	32	62.9	22.46	6.54
25	Arkansas Rowden 4053	5.3	24.1	874	30.6	267	—200	31	58.8	18.71	6.41
26 ck		14.3	36.7	1476	32.2	475		31	82.6	32.89	8.55

[1]Same varieties and strains as reported in Table I.
[2]Based on percentage of total crop harvested at the first picking.
[3]Seed cotton.

affected with wilt that it seemed probable they would die and be lost before the end of the season were removed at the time counts were made and so recorded in the notes. When there was any doubt regarding the presence of the wilt in a particular plant, a cut was made to determine whether or not vascular discoloration was present.

Table 1 lists the varieties included in the 1931 test and indicates the seasonal incidence of the disease from late June until cotton had nearly matured, when further counts were impractical because of the mature condition of the plants. The incidence of cotton wilt in the check variety, Trice 304, was about the same as in 1930, but in both years there was much less wilt on the same land than in previous years.

At harvest time 100-boll samples were taken from each variety in each series. The number of bolls to the pound of seed cotton, the percentage of lint, the length of staple, and the number of days (calculated by use of a factor) required to pick a bale were determined from the boll samples. Two pickings were made, and the first expressed as a percentage of the total yield indicated relative earliness among varieties. The total plot yields of the three series were converted to an acre basis for seed cotton production and the acre yield of lint was obtained through computation by use of the lint percentage determination. The column "Lint yield difference from check" expresses the actual yield as compared with the interpolated check yield. The acre value of seed and lint, or the crop value, was computed on the basis of the seasonal price of seed and lint with the proper evaluation placed on length of fiber. Table 2 repeats the final wilt count from the previous table and presents the harvest results as listed here.

Experimental Results, 1932. Studies of wilt resistance in 1932 were carried out on the same land as in 1931 and years previous to that with no important changes in experimental methods. Certain varieties were dropped and other varieties substituted. The same number of varieties was employed as in the preceeding season and they were planted on May 9. Inoculum was applied and no fertilizer used.

Table 3 gives the seasonal incidence of cotton wilt and Table 4 represents the final wilt count with the various determinations made for the varieties from the harvest data. In these two tables the same plan of presentation is followed as with Tables 1 and 2 for 1931.

TABLE 3. DEVELOPMENT OF COTTON WILT SHOWING PERCENTAGE OF PLANTS WILTED AT SEVERAL DATES IN WILT-RESISTANT AND WILT-SUSCEPTIBLE VARIETIES IN ARTIFICIALLY INOCULATED LAND, THE THREE SERIES AVERAGED, 1932

Order planted and row number	Variety name and strain number	Percentage of Wilted Plants							
		June 27	July 7	July 18	July 27	Aug. 9	Aug. 18	Aug. 29	Sept. 7
1 ck	Trice 304	.5	3.3	4.3	4.7	5.0	5.7	6.2	6.2
2	Arkansas 17	.5	1.9	1.9	2.0	2.1	2.2	2.2	2.2
3	Express 317	.5	2.5	2.5	2.8	3.0	3.2	3.6	4.1
4	Missdel 2	1.0	5.9	6.5	7.2	8.9	9.9	9.9	9.9
5	Delfos 668	1.6	6.5	6.5	6.8	6.9	8.1	8.1	8.5
6 ck		.7	3.8	4.2	4.3	5.2	6.8	6.8	6.8
7	Dixie-Triumph (La.)	.2	.7	.7	.9	.9	1.1	1.3	1.6
8	Dixie-Triumph (Watson)	.3	.8	.9	1.0	1.3	1.4	1.5	1.5
9	Clevewilt 3079	.6	2.9	2.9	2.9	2.9	2.9	2.9	3.0
10	Clevewilt	.6	3.0	3.0	3.0	3.0	3.1	3.1	3.3
11 ck		.9	4.7	5.0	6.1	7.0	8.3	8.3	8.3
12	Dixie 14	.3	.8	.8	.8	.9	1.2	1.5	1.6
13	Half and Half	2.0	12.8	18.4	21.5	21.8	22.6	22.6	24.3
14	Wilson Type Big Boll	1.3	6.9	6.9	7.2	7.2	7.2	7.2	7.2
15	D. and P. L. 10	.9	6.1	6.9	6.9	7.7	9.1	9.1	9.1
16 ck		1.3	5.0	5.3	5.5	6.0	7.3	7.3	7.4
17	Cleveland 54	1.2	3.6	3.6	3.8	4.0	4.2	4.2	4.4
18	Arkansas Acala 34	1.4	6.4	6.4	6.7	7.1	7.6	7.6	7.7
19	Arkansas Rowden 2088	.4	3.6	3.6	3.6	3.7	3.8	3.8	3.8
20	Miller	.3	1.4	1.9	1.9	1.9	2.0	2.3	2.3
21 ck		.9	4.4	4.4	5.5	5.8	5.9	5.9	6.1
22	Arkansas Rowden 40	1.0	3.6	4.3	4.3	4.3	4.6	4.6	4.6
23	Stoneville 3	.9	4.6	4.9	4.9	5.3	6.2	6.2	6.2
24	Arkansas Rowden 1049	.4	2.4	2.8	2.8	2.8	2.8	2.8	2.8
25	Arkansas Lone Star 2124	.2	2.2	2.7	2.8	2.8	3.3	3.3	3.3
26 ck		.7	5.1	5.9	6.0	6.3	6.6	6.6	6.6

TABLE 4. FINAL PERCENTAGE OF PLANTS WILTED COMPARED WITH EARLINESS, SEED COTTON YIELD, LINT PERCENTAGE, LINT YIELD, STAPLE LENGTH, SIZE OF BOLLS, CROP VALUE, AND RELATIVE EASE OF PICKING; NO FERTILIZER USED, 1932

Order planted and row number	Variety name and strain number[1]	Total plants wilted	Earliness[2]	Acre yield of seed cotton	Lint	Acre yield of lint	Lint yield difference from ck	Staple length	Bolls to the pound[3]	Acre value of seed and lint	Time required to pick a bale
		Per cent	*Per cent*	*Pounds*	*Per cent*	*Pounds*	*Pounds*	*32nds*	*Number*	*Dollars*	*Days*
1 ck	Trice 304	6.2	80.5	769	33.3	256		31	111.1	19.57	11.11
2	Arkansas 17	2.2	67.7	845	32.4	274	+ 15	34	95.2	22.29	9.80
3	Express 317	4.1	66.1	665	32.7	217	− 45	34	90.9	17.71	9.26
4	Missdel 2	9.9	81.7	627	34.1	214	− 52	33	113.6	16.98	11.11
5	Delfos 668	8.5	77.8	834	30.6	255	− 14	34	92.6	21.08	10.10
6 ck		6.8	79.4	808	33.7	272		32	108.7	21.15	10.75
7	Dixie-Triumph (La.)	1.6	60.5	1005	34.2	344	+ 75	30	87.7	25.77	8.55
8	Dixie-Triumph (Watson)	1.5	63.0	874	33.3	291	+ 26	33	92.6	23.20	9.26
9	Clevewilt 3079	3.0	49.2	734	33.3	244	− 18	33	98.0	19.46	9.80
10	Clevewilt	3.3	63.0	764	33.7	257	− 1	34	99.0	20.86	9.80
11 ck		8.3	81.2	757	33.7	255		30	112.4	19.16	11.11
12	Dixie 14	1.6	52.7	879	33.3	293	+ 38	32	87.7	22.82	8.77
13	Half and Half	24.3	74.5	623	45.0	280	+ 25	24	90.1	19.52	6.67
14	Wilson Type Big Boll	7.2	74.5	759	33.6	255	− 1	29	90.9	18.94	9.00
15	D. and P. L. 10	9.1	70.0	788	35.3	278	+ 22	33	98.0	21.93	9.26
16 ck		7.4	80.7	786	32.6	256		32	105.3	20.03	10.75
17	Cleveland 54	4.4	70.8	923	34.5	318	+ 59	31	86.2	24.14	8.33
18	Arkansas Acala 34	7.7	81.3	691	34.5	238	− 24	33	90.9	18.85	8.77
19	Arkansas Rowden 2088	3.8	73.9	820	33.6	276	+ 11	32	73.0	21.46	7.25
20	Miller	2.3	67.1	881	34.2	301	+ 33	32	68.5	24.34	6.67
21 ck		6.1	79.5	782	34.7	271		31	105.3	20.57	10.10
22	Arkansas Rowden 40	4.6	73.9	799	33.3	266	− 5	32	77.5	20.73	7.75
23	Stoneville 3	6.2	80.0	923	35.9	331	+ 60	33	97.1	26.03	9.00
24	Arkansas Rowden 1049	2.8	76.9	865	35.5	307	+ 36	32	72.5	23.64	6.80
25	Arkansas Lone Star 2124	3.3	79.4	1074	33.6	361	+ 90	34	80.0	29.30	7.94
26 ck		6.6	80.9	804	33.7	271		32	105.3	21.07	10.42

[1]Same varieties and strains as reported in Table 3.
[2]Based on percentage of total crop harvested at the first picking.
[3]Seed cotton.

Experimental Results, 1933. The work was continued very much as in 1932. Inoculum was placed in the bed, no fertilizer was applied, and seed was planted April 25. Certain changes in varieties and strains were made, and certain improvements in technique were effected. As counts were made, each plant which appeared to be affected with cotton wilt was tagged with a dated tag in order that information might be secured as to whether there was any recovery sufficient to make the identification of the affected plants later in the season difficult or impossible. Results did not indicate that this happened in any case in 1933. The season was especially favorable for the development of cotton wilt and afforded an unusually severe test of varietal resistance. The counts of wilted plants were much higher in 1933 than in the 2 preceeding years.

In Table 5, the seasonal development of cotton wilt for 1933 is reported. Table 6 gives the final percentage of plants for that year in addition to the harvesting data and the computed evaluations.

TABLE 5. DEVELOPMENT OF COTTON WILT SHOWING PERCENTAGE OF PLANTS WILTED AT SEVERAL DATES IN WILT-RESISTANT AND WILT-SUSCEPTIBLE VARIETIES IN ARTIFICIALLY INOCULATED LAND, THREE SERIES AVERAGED, 1933

Order planted and row number	Variety name and strain number	Percentage of Wilted Plants						
		July 5	July 15	July 25	Aug. 5	Aug. 15	Aug. 25	Sept. 4
1 ck	Trice 304	4.0	8.8	11.8	16.8	20.0	25.8	32.3
2	Missdel (Wilt Resistant)	3.1	6.3	8.2	9.4	12.6	16.2	25.2
3	Missdel 3	4.5	12.4	19.0	27.2	32.8	38.2	48.1
4	Missdel 4	6.4	14.7	22.2	32.0	38.6	43.1	51.8
5	Delfos 668	4.4	7.7	11.6	16.6	17.9	20.6	26.5
6 ck		3.9	7.1	9.7	14.0	17.9	22.9	28.9
7	Dixie-Triumph	.7	1.0	1.4	1.8	2.0	2.7	3.8
8	Dixie-Triumph 6	2.6	4.6	6.1	6.5	7.8	8.7	10.7
9	Clevewilt 3079	1.9	2.2	3.2	3.9	4.7	7.0	9.6
10	Clevewilt	2.4	4.1	5.2	6.0	6.6	8.7	12.1
11 ck		4.2	9.6	12.0	16.4	20.5	22.3	26.4
12	Dixie 14	.7	1.1	1.3	1.7	1.7	2.8	4.1
13	Half and Half	20.5	31.2	44.4	53.1	59.5	61.4	64.9
14	Wilson Type Big Boll	4.9	10.2	13.2	16.0	17.9	20.4	22.6
15	D. and P. L. 11	6.6	11.7	14.9	21.0	25.0	27.7	33.4
16 ck		3.7	8.0	9.3	15.7	20.1	26.0	32.4
17	Dixie 14-1	1.2	2.0	3.7	4.0	5.0	6.1	8.3
18	Arkansas Lone Star 2124	1.3	2.5	4.0	5.2	7.9	10.7	14.5
19	Arkansas Rowden 2088	1.3	1.6	2.4	3.7	4.4	5.5	7.8
20	Stoneville 3	2.5	6.4	11.6	18.2	25.2	28.2	35.3
21 ck		2.6	4.3	7.3	11.0	16.4	18.8	27.6
22	Arkansas Rowden 40	1.3	2.6	3.3	4.9	5.8	6.9	9.0
23	Stoneville 5	2.7	6.1	11.0	20.5	27.3	28.9	33.9
24	Arkansas Rowden 1049	1.4	3.0	3.5	5.6	7.3	8.9	11.4
25	Qualla	11.9	29.7	36.9	45.0	47.7	52.0	55.2
26 ck		1.9	7.0	10.3	13.5	16 6	19.1	25.3

TABLE 6. FINAL PERCENTAGE OF PLANTS WILTED COMPARED WITH EARLINESS, SEED COTTON YIELD, LINT PERCENTAGE, LINT YIELD, STAPLE LENGTH, SIZE OF BOLLS, CROP VALUE, AND RELATIVE EASE OF PICKING; NO FERTILIZER USED 1933

Order planted and row number	Variety name and strain number[1]	Total plants wilted	Earliness[2]	Total yield of seed cotton	Lint	Lint yield	Lint yield difference from ck	Staple length	Bolls to the pound[3]	Acre value of seed and lint	Time required to pick a bale
		Per cent	*Per cent*	*Pounds*	*Per cent*	*Pounds*	*Pounds*	*32nds*	*Number*	*Dollars*	*Days*
1 ck	Trice 304	32.3	85.3	755	33.0	249		32	89.3	28.19	9.00
2	Missdel 6 (Wilt Resistant)	25.2	88.7	754	32.6	246	+ 3	35	72.5	29.65	7.41
3	Missdel 3	48.1	84.6	502	32.2	162	− 75	36	84.7	20.17	8.77
4	Missdel 4	51.8	92.4	569	33.9	190	− 41	34	91.7	22.50	9.00
5	Delfos 668	26.5	89.6	929	31.2	290	+ 62	35	82.0	35.20	8.77
6 ck		28.9	92.6	672	32.7	220		33	90.9	25.37	9.26
7	Dixie-Triumph	5.8	81.5	979	33.9	332	+ 110	32	80.6	37.22	7.94
8	Dixie-Triumph 6	10.7	84.4	783	35.4	277	+ 61	33	76.9	32.10	7.25
9	Clevewilt 3079	9.6	86.4	680	34.5	234	+ 19	34	84.7	27.53	8.13
10	Clevewilt	12.1	86.9	776	35.9	279	+ 67	33	85.5	31.96	7.94
11 ck		26.4	91.2	634	33.3	211		32	90.1	23.72	9.00
12	Dixie 14	4.1	81.2	887	36.2	322	+ 113	32	78.7	35.39	7.25
13	Half and Half	64.9	83.1	449	42.9	193	− 13	35	79.4	19.27	6.17
14	Wilson Type Big Boll	22.6	87.9	748	33.9	253	+ 50	31	82.6	27.74	8.13
15	D. P. and L. 11	33.4	91.2	711	41.1	293	+ 93	34	88.5	33.57	7.25
16 ck		32.4	91.7	604	33.0	199		32	94.3	22.44	9.52
17	Dixie 14-1	8.3	86.9	750	34.9	262	+ 58	32	79.4	29.37	7.58
18	Arkansas Lone Star 2124	14.5	92.8	698	35.1	245	+ 36	34	76.3	28.55	7.25
19	Arkansas Rowden 2088	7.8	90.6	632	34.0	215	− 1	32	85.4	25.90	6.11
20	Stoneville 3	35.3	94.3	683	37.4	255	+ 35	32	93.5	27.99	8.33
21 ck		27.6	91.3	663	33.9	225		32	91.7	25.43	9.00
22	Arkansas Rowden 40	9.6	86.5	698	34.3	239	+ 12	33	71.4	27.86	6.94
23	Stoneville 5	33.9	93.6	665	37.8	251	+ 23	33	90.1	28.91	7.94
24	Arkansas Rowden 1049	11.4	88.3	645	34.2	221	− 9	32	64.1	24.86	6.29
25	Qualla	55.2	67.6	429	38.8	166	− 65	32	62.5	18.11	5.38
26 ck		28.3	82.9	604	35.6	233		32	90.9	26.20	9.00

[1]Same varieties and strains as reported in Table 5
[2]Based on percentage of total crop harvested at the first picking.
[3]Seed cotton

Studies on the Relation of Fertilizers to the Incidence of Cotton Wilt

In previous work on the relation of fertilizers to cotton wilt at the Cotton Branch Experiment Station *(loc. cit.)*, results were presented in which a series of fertilizers based on 500 pounds of a 4-10-4 (N P K) fertilizer was used and in addition relatively high amounts of nitrate, superphosphate, and muriate of potash were used alone. Cottonseed meal was also used at the rate of 600 pounds per acre. At the same time, a series of outlying tests was made at various points in central and eastern Arkansas where fertilizers based on 600 pounds of a 6-8-6 fertilizer were used. These studies indicated that when cotton wilt and "rust," or potash hunger, are important factors, 500 pounds of a 4-10-4 fertilizer is inadequate for the control of these diseases. For this reason the 4-10-4 formula was discarded and all fertilizers used were based on 600 pounds of 6-8-6 fertilizer per acre. However, one series of plots based on 500 pounds of the 4-10-4 formula was retained in order that its efficiency might be further checked. In previous years, no results were obtained from applications of 600 pounds of cottonseed meal per acre, and this treatment

Table 7. Effect of Various Fertilizers on the Incidence of Cotton Wilt and Yield of Seed Cotton, Cotton Branch Experiment Station Lee County, Arkansas, 1932

Plot Treatment		Percentage of Wilted Plants					Acre yield of seed cotton
Formula	Amount applied to the acre	June 27	July 12	July 28	Aug. 17	Sept. 12	
							Pounds
Check	No fertilizer	1.2	3.6	5.9	10.1	10.5	474
6- 0- 0	Nitrate of soda, 240 pounds	.80	2.8	4.7	7.4	8.9	686
6- 8- 0	Nitrate of soda, 240 pounds Superphosphate, 300 pounds	.93	3.3	5.0	9.7	10.0	638
6- 8- 6	Nitrate of soda, 240 pounds Superphosphate, 300 pounds Muriate of potash, 72 pounds	.97	2.8	3.7	4.9	7.1	857
6- 8-12	Nitrate of soda, 240 pounds Superphosphate, 300 pounds Muriate of potash, 144 pounds	1.1	2.7	3.5	4.4	5.5	785
Check	No fertilizer	1.9	5.0	6.2	11.3	11.7	441
4-10- 4	Nitrate of soda, 133 pounds Superphosphate, 313 pounds Muriate of potash, 40 pounds	1.1	2.4	3.8	6.5	7.2	768
0- 0-12	Kainit, 15 per cent, 480 pounds	.62	2.5	2.6	3.2	4.6	679
0- 0-12	Muriate of potash, 144 pounds	.26	1.9	2.5	4.3	5.5	685
0- 8- 0	Superphosphate, 300 pounds	1.5	4.1	7.3	12.2	12.3	452
Check	No fertilizer	1.7	4.4	6.5	12.1	12.3	384

was therefore omitted. Each plot equaled one-fortieth of an acre and four series of plots were used. The soil was a Lintonia silt loam upon which cotton had previously been planted for many years, and observations made since 1930 indicated that cotton suffered severely each year from potash hunger and cotton wilt. Fertilizer was applied under the bed on April 26, 1932, and plots were planted to Trice 304 cotton on May 7. The results given in Table 7 are the combined data from the four series. Yield records are reduced to an acre basis.

In Table 7 and in succeeding tables amounts of nitrate, superphosphate, muriate of potash and 15 per cent kainit applied per acre are used rather than a certain weight of a certain analysis fertilizer. These amounts as before stated are all based on 600 pounds of 6-8-6 fertilizer per acre, excepting one series treated with 500 pounds of 4-10-4 fertilizer. Six hundred pounds of a 6-8-6 fertilizer calls for 240 pounds of nitrate of soda, 300 pounds of superphosphate and 72 pounds of muriate of potash. Cotton wilt counts were made at intervals varying from 2 to 3 weeks throughout the growing season.

The "wilt-fertilizer" data for 1933 are presented in Table 8.

TABLE 8. EFFECT OF VARIOUS FERTILIZERS ON THE INCIDENCE OF COTTON WILT AND YIELD OF SEED COTTON, COTTON BRANCH EXPERIMENT STATION LEE COUNTY, ARKANSAS, 1933

Formula	Amount applied to the acre	Percentage of Wilted Plants					Acre yield of seed cotton
		July 5	July 20	Aug. 5	Aug. 20	Sept. 5	
							Pounds
Check	No fertilizer	4.0	10.5	13.3	20.6	37.2	644
6- 0- 0	Nitrate of soda, 240 pounds	2.1	7.0	9.7	17.9	31.8	1123
6- 8- 0	Nitrate of soda, 240 pounds Superphosphate, 300 pounds	2.8	5.2	12.4	22.2	37.2	994
6- 8- 6	Nitrate of soda, 240 pounds Superphosphate, 300 pounds Muriate of potash, 72 pounds	.8	2.8	4.5	8.2	13.3	1665
6- 8-12	Nitrate of soda, 240 pounds Superphosphate, 300 pounds Muriate of potash, 144 pounds	.9	4.1	5.3	7.0	8.1	1813
Check	No fertilizer	4.4	7.4	10.5	16.3	28.2	692
4-10- 4	Nitrate of Soda, 133 pounds Superphosphate, 313 pounds Muriate of potash, 40 pounds	1.5	4.2	6.7	10.2	20.1	1344
0- 0-12	Kainit, 15 per cent, 480 pounds	.8	3.1	5.6	6.5	8.5	1075
0- 0-12	Muriate of potash, 144 pounds	1.1	3.9	5.1	6.0	6.9	1138
0- 8- 0	Superphosphate, 300 pounds	5.9	12.7	16.5	23.9	40.1	672
Check	No fertilizer	6.1	14.0	16.8	23.2	37.6	643
	Manure, 10 tons	3.2	10.4	11.2	15.0	18.9	1624

The same piece of land and the same arrangement of plots were used, great care being taken to locate each plot exactly as in the preceeding year. An additional plot fertilized with stable manure at the rate of 10 tons per acre was added to each series, the space occupied by the manure plots having been left unfertilized in 1932. Trice 304 cotton was again used. Fertilizer was applied under the bed early in May and the cotton seed was planted May 17, 1933.

Wilt Resistance and the Effect of Fertilizers on the Incidence of Cotton Wilt

In previous papers *(loc. cit.)* data are presented on the wilt resisting qualities of a considerable number of cotton varieties, and in addition, work has been presented showing the value of potash fertilizers for the control of "rust", or potash hunger, and cotton wilt. From these data, it would appear that the logical recommendation is to use a combination consisting of a suitable wilt resistant variety and high potash fertilizer for the most efficient control of cotton wilt and "rust". Accordingly, an experiment embodying these ideas and designated as the "combined test" was prepared. Two series of plots each, consisting of six different fertilizer treatments and four nonfertilized check plots, were used. One-half of each plot was planted to Missdel 2, a wilt-susceptible

Table 9. Combined Test, Brittain Place, Near Marianna, Arkansas, Variety, Missdel 2, Planted in Duplicate Series, 1933

Formula	Plot Treatment[1] Amount applied to the acre	Percentage of Wilted Plants July 6	July 21	Aug. 7	Aug. 21	Sept. 6	Acre yield of seed cotton
							Pounds
Check	No fertilizer	10.0	14.0	15.2	24.4	29.9	871
6- 8- 0	Nitrate of soda, 240 pounds Superphosphate, 300 pounds	6.6	13.4	18.4	25.0	34.5	1072
6- 8-12	Nitrate of soda, 240 pounds Superphosphate, 300 pounds Muriate of potash, 144 pounds	7.5	9.7	10.2	12.7	16.4	1424
Check	No fertilizer	12.9	16.6	22.4	29.9	36.3	795
6- 8- 4	Nitrate of soda, 240 pounds Superphosphate, 300 pounds Muriate of potash, 48 pounds	10.3	13.9	15.7	19.1	27.3	1134
0- 0-3.33	Kainit, 20 per cent, 100 pounds	7.8	12.2	15.4	18.6	25.5	1019
Check	No fertilizer	10.2	16.4	20.2	27.6	38.1	769
0- 0- 11.33	Kainit, 20 per cent, 340 pounds	7.4	9.6	10.0	11.5	11.6	1061
0- 0- 5	Kainit, 20 per cent, 150 pounds	7.4	8.9	9.8	11.0	14.9	947
Check	No fertilizer	9.7	14.4	17.9	27.7	35.7	741

[1]All fertilizer applied on the basis of 600 pounds per acre of 6-8-6 unless otherwise specified.

variety and one-half to Arkansas Rowden 2088, a moderately wilt-resistant variety, making essentially two separate tests with the same fertilizer treatments but with different varieties. The land used was a silt loam known from previous observations to be thoroughly infested with the cotton wilt fungus. Fertilizer was applied in advance of planting as in previous experiments, and seed was planted May 16, 1933. For convenience, data for the two varieties employed are presented in separate tables, for Missdel 2 in Table 9, and Arkansas Rowden 2088 in Table 10.

TABLE 10. COMBINED TEST, BRITTIAN PLACE, NEAR MARIANNA, ARKANSAS, VARIETY, ARKANSAS ROWDEN 2088, PLANTED IN DUPLICATE SERIES, 1933

Formula	Plot Treatment[1]	Percentage of Wilted Plants					Acre yield of seed cotton
	Amount applied to the acre	July 6	July 21	Aug. 7	Aug. 21	Sept. 6	
							Pounds
Check	No fertilizer	4.4	4.4	4.6	4.8	5.4	992
6- 8- 0	Nitrate of soda, 240 pounds Superphosphate, 300 pounds	1.6	2.3	2.3	2.4	2.8	1278
6- 8-12	Nitrate of soda, 240 pounds Superphosphate, 300 pounds Muriate of potash, 144 pounds	2.0	2.0	2.0	2.0	2.1	1573
Check	No fertilizer	5.7	5.7	5.8	6.1	6.8	899
6- 8- 4	Nitrate of soda, 240 pounds Superphosphate, 300 pounds Muriate of potash, 48 pounds	2.1	2.4	2.4	2.7	3.4	1357
0- 0- 3.33	Kainit, 20 per cent, 100 pounds	2.4	2.7	2.7	2.9	3.3	1019
Check	No fertilizer	3.7	3.9	4.0	4.4	5.5	967
0- 0- 11.33	Kainit, 20 per cent 340 pounds	2.2	2.4	2.4	2.4	2.4	1037
0- 0- 5	Kainit, 20 per cent, 150 pounds	1.7	2.0	2.0	2.0	3.2	1132
Check	No fertilizer	4.0	4.1	4.1	4.8	5.9	958

[1]All fertilizer applied on the basis of 600 pounds per acre of 6-8-6 unless otherwise specified.

DISCUSSION OF RESULTS

Previous studies *(loc. cit.)* showed that on sandy alluvial soils where cotton wilt and "rust" are often found together in a severe form, a combination of a suitable wilt resistant variety and the judicious use of a fertilizer containing potash proved the best solution of the cotton wilt problem. The following varieties were found to be suitable for Arkansas conditions and extremely resistant to cotton wilt: Dixie-Triumph (Watson), Dixie-Triumph (Marett), Dixie 14, Lightning Express, Super Seven (Coker), and Miller. Moderately resistant or wilt-tolerant varieties suitable for Arkansas conditions were found to be Arkansas Rowden

40, Arkansas 17, Arkansas Rowden 2088, D. & P. L. 6, Express 121, D. & P. L. 4, Cleveland 54, Arkansas Rowden 2119, and Wilson Type Big Boll.

Conditions from 1930 to 1932 apparently did not favor the development of the cotton wilt disease, and the most susceptible varieties of cotton were not severely affected at the Cotton Branch Experiment Station, but in 1933 more cotton wilt developed than for several years. In spite of the fluctuations in the incidence of cotton wilt from year to year, the relative amount of wilt resistance exhibited by these tested varieties did not change within the limits of experimental error.

The purposes of the work have been primarily to establish the wilt resistance of a sufficient number of varieties of cotton so that desirable selection of very resistant and moderately resistant varieties might be available for the varied conditions under which cotton is grown in Arkansas; to ascertain the wilt-resisting qualities of the various promising strains of cotton which, over a period of years, have been developed by the Arkansas Agricultural Experiment Station; to supplement the general cotton breeding program of the station by determining the degree of disease resistance possessed by all strains developed; and to determine the value of new wilt resistant varieties developed elsewhere.

In accordance with these purposes the varieties and strains tested during the 3-year period 1931 to 1933, have been placed in five groups and designated: Group A, varieties or strains developed or in the process of development at the Arkansas Station; Group B, wilt-resistant varieties or strains more recently developed outside Arkansas; Group C, wilt-susceptible and wilt-tolerant varieties or strains of recent introduction; Group D, older wilt-resistant varieties; and Group E, older wilt-susceptible varieties. All the strains or varieties developed by the Arkansas station are placed in Group A irrespective of the amount of wilt infection.

In the previous work *(2)* the varieties and strains tested were divided arbitrarily into three groups. The first group included those having not over 3 per cent of plants wilted and this group was designated as wilt-resistant; the second group included those having between 3 per cent and 7.2 per cent of plants wilted which was designated as wilt tolerant, and the third group embraced all varieties and strains having more than 7.2 per cent wilted plants and was considered wilt susceptible.

There is some question as to what percentage of wilt is necessary to actually reduce yields. With good stands of cotton, a considerable number of plants may break down or become partially infected without reducing the yield of the crop. The number of diseased plants necessary to cause curtailment of production is also dependent upon the fertility of the land, the season, and the

inroads of other agencies that have tendencies in reducing yields. If the seasonal and other conditions are favorable, and the degree of soil fertility is average or better, the plants that remain vigorous and healthy tend to vegetate and set bolls to such an extent that they occupy much of the space of dead or diseased plants.

The division limits between the three categories are of an arbitrary nature, but for the purpose of discussion some definition is necessary. In this bulletin, it will be assumed that varieties and strains always with 5 per cent or less of plants wilted in any of the 3 years tested are wilt resistant, that varieties and strains in all cases ranging between 5 to 10 per cent of plants wilted are wilt tolerant, and that varieties and strains with percentages of plants wilted above 10 per cent are wilt susceptible. In previous works *(loc. cit.)*, this limit was set at 7.2 per cent, but it is believed now that 10 per cent is not too high and that 5 per cent is not too high for the upper limit of wilt resistance.

The five groups of varieties according to the classification heretofore indicated are as follows:

GROUP A: Varieties or strains developed or in the process of development at the Arkansas station.

	Variety or Strain	Percentage of Plants wilted	Lint yield difference from check	Check yield
1931	Arkansas Rowden 2088	1.9	—126	
	Arkansas Rowden 40	2.7	—117	
	Arkansas 17	3.1	— 83	
	Arkansas Rowden 2119	4.2	—135	
	Arkansas Rowden 4053	5.3	—200	
	Arkansas Acala 34	8.8	— 62	
	Average of all checks (Trice 304)	12.6		436
1932	Arkansas 17	2.2	+ 15	
	Arkansas Rowden 1049	2.8	+ 36	
	Arkansas Lone Star 2124	3.3	+ 90	
	Arkansas Rowden 2088	3.8	+ 11	
	Arkansas Rowden 40	4.6	— 5	
	Arkansas Acala 34	7.7	— 24	
	Average of all checks (Trice 304)	6.9		263
1933	Arkansas Rowden 2088	7.8	+ 1	
	Dixie 14-1	8.3	+ 58	
	Arkansas Rowden 40	9.0	+ 12	
	Dixie Triumph 6	10.7	+ 61	
	Arkansas Rowden 1049	11.4	— 9	
	Arkansas Lone Star 2124	14.5	+ 36	
	Average of all checks (Trice 304)	28.8		223

GROUP B: Wilt resistant varieties or strains developed outside of Arkansas more recently.

	Variety or Strain	Percentage of Plants wilted	Lint yield difference from check	Check yield
1931	Super Seven 5	0.7	— 26	
	Miller	1.3	—149	
	D. and P. L. 6	1.8	— 72	
	Express 317	1.9	— 91	
	Cleveland 54	4.5	— 15	
	Average of all checks (Trice 304)	12.6		436
1932	Miller	2.3	+ 33	
	Express 317	4.1	— 45	
	Cleveland 54	4.4	+ 59	
	Average of all checks (Trice 304)	6.9		263
1933	None introduced			

GROUP C: Wilt susceptible and wilt tolerant varieties or strains of recent introduction.

	Variety or Strain	Percentage of Plants wilted	Lint yield difference from check	Check yield
1931	Wilson Type Big Boll	5.0	+ 54	
	Wilt Cleveland 29-1	9.9	— 83	
	Delfos 668	10.2	— 35	
	D. and P. L. 10	11.6	+ 3	
	Missdel 2	17.7	— 93	
	Average of all checks (Trice 304)	12.6		436
1932	Clevewilt 3079	3.0	— 18	
	Clevewilt	3.3	— 1	
	Stoneville 3	6.2	+ 60	
	Wilson Type Big Boll	7.2	— 1	
	Delfos 668	8.5	— 14	
	D.and P. L. 10	9.1	+ 22	
	Missdel 2	9.9	— 52	
	Average of all checks (Trice 304)	6.9		263
1933	Clevewilt 3079	9.6	+ 19	
	Clevewilt	12.1	+ 67	
	Wilson Type Big Boll	22.6	+ 50	
	Missdel Wilt Resistant	25.2	+ 3	
	Delfos 668	26.5	+ 62	
	D. and P. L. 11	33.4	+ 93	
	Stoneville 5	33.9	+ 23	
	Stoneville 3	35.3	+ 35	
	Missdel 3	48.1	— 75	
	Missdel 4	51.8	— 41	
	Qualla	55.2	— 65	
	Average of all checks (Trice 304)	28.8		223

GROUP D: Older wilt resistant varieties.

	Variety or Strain	Percentage of Plants wilted	Lint yield difference from check	Check yield
1931	Dixie-Triumph (Watson)	0.7	— 50	
	Dixie 14	1.2	—102	
	Dixie-Triumph (La.)	1.9	+ 50	
	Average of all checks (Trice 304)	12.6		436
1932	Dixie-Triumph (Watson)	1.5	+ 26	
	Dixie 14	1.6	+ 38	
	Dixie-Triumph (La.)	1.6	+ 75	
	Average of all checks (Trice 304)	6.9		263
1933	Dixie-Triumph (La.)	3.8	+110	
	Dixie 14	4.1	+113	
	Average of all checks (Trice 304)	28.8		223

GROUP E: Older wilt susceptible varieties.

	Variety or Strain	Percentage of Plants wilted	Lint yield difference from check	Check yield
1931	Half and Half	7.7	+ 57	
	Average of all checks (Trice 304)	12.6		436
1932	Half and Half	24.3	+ 25	
	Average of all checks (Trice 304)	6.9		263
1933	Half and Half	64.9	— 13	
	Average of all checks (Trice 304)	28.8		223

It has been pointed out above that 10 per cent and sometimes a considerable higher percentage of wilted plants may not reduce yields. Trice 304 is a very prolific early variety, has a high lint percentage for Trice, and usually produces a good yield unless its production is cut down by heavy wilt attacks. It will be noted that the check yield was much higher in 1931 than in 1932 and 1933. This difference may be largely attributed to the heavy application of nitrate of soda in 1931, seasonal difference in yield, and the relative amount of wilt infection. Seasonal conditions in 1931 and 1933 were more favorable for cotton production than in 1932. The percentage of wilted plants in the first two seasons

was hardly sufficient to materially reduce production, but in 1933 the disease attacks were much more severe and doubtless curtailed yields materially.

All of the wilt-resistant and wilt-tolerant varieties and strains grown in 1931, except Dixie-Triumph from the Louisiana Experiment Station, were lower in yield than the check average. These minus yields are largely due to the fact that Trice 304 was not materially reduced in production in 1931 through wilt attacks.

The wilt-resistant and wilt-tolerant varieties and strains made a better showing in reference to check yields in 1932 and especially in 1933. In the latter season the heavier wilt attacks on Trice 304 tended to make the varieties and strains that were infected to a less degree more prominent in their production.

The wilt-susceptible varieties and strains, except Half and Half and D. & P. L., were lower than the check average in 1931. In 1932 the wilt-susceptible varieties and strains ranged from somewhat above to somewhat below the check average in yield, but in no case were the higher yields correlated with lower wilt counts or *vice versa*. The infestation seemed not sufficiently pronounced to affect production.

In 1933, the wilt susceptible varieties and strains exceeded the check average in yield until the percentage of wilted plants reached approximately 48 per cent. The four varieties, Missdel 3, Missdel 4, Qualla, and Half and Half, that had a percentage of infection above 48 per cent were reduced in yield below that of the check which in turn was also reduced somewhat in production by wilt.

It has just been pointed out that relationship between wilting percentage and yields does not begin to show correlation until the incidence of cotton wilt infection is comparatively high. No correlation between wilt counts and any of the other economic characters of the cotton plants, such as earliness, lint percentage, staple length, or boll size, seemed to prevail. The apparent correlation between earliness and wilt susceptibility is doubtless attributable to the fact that wilt attacks cause premature opening in plants affected with the disease and thus appear to be earlier in maturity than if the plants had not become infected.

Relation of fertilizers to cotton wilt. Previously published work *(loc. cit.)* indicated that better control of cotton wilt and "rust," or potash hunger, is to be expected when relatively large amounts of potash are applied. For this reason 600 pounds of 6-8-6 was used as a basis for the various treatments and nitrate of soda, phosphate and muriate of potash were omitted singly. In addition a series of plots fertilized with 6-8-12 fertilizer served to double the amount of muriate of potash and a series treated with muriate of potash and 15 per cent kainit each used alone on a

basis equivalent to the 0-0-12 formula provided similar heavy applications of potash alone. In 1933 ten tons of stable manure was used in a series of plots in an effort to secure results comparable to those of Fulton in Louisiana *(1)*.

As has been noted before, the incidence of cotton wilt was low in 1932, the untreated checks of Trice 304 showing on the average only about 11.5 per cent of wilted plants.

In 1933 on the other hand the checks of Trice 304 showed about 34 per cent of wilted plants. In both 1932 and 1933 the application of 240 pounds per acre of nitrate of soda (6-0-0) alone gave a very distinct increase in yield of seed cotton (nearly 50 per cent in 1932 and nearly 75 per cent in 1933) and a slight decrease in the incidence of cotton wilt in both cases.

In both years an application consisting of 240 pounds of nitrate of soda and 300 pounds of superphosphate (6-8-0) gave decided increases in yield (about 33.3 per cent in 1932 and slightly more in 1933). In these two seasons nitrate and phosphate in combination gave no decrease in the amount of cotton wilt, and 300 pounds of superphosphate alone not only had no definite effect on the yield of seed cotton, but actually seemed to cause a slight increase in amount of cotton wilt. On the other hand when potash either alone or in mixed fertilizer was used in 1932 and in 1933, there was a definite increase in yield over unfertilized checks and other plots from which potash was omitted. Even more effective were the potash-containing fertilizers in reducing the amount of cotton wilt, the decreases in 1933 being from 33.3 per cent on the unfertilized checks to as low as 6.9 per cent for the higher potash applications. Both kainit and muriate of potash when applied alone at the rates used were fully as effective as the same amount of potash in a 6-8-12 fertilizer so far as reduction of cotton wilt and "rust" is concerned but gave considerably smaller increases in yields of seed cotton.

Only one year's results with stable manure are available. Ten tons of manure gave an increase in yield practically equal to the increase resulting from the application of 600 pounds of a 6-8-6 fertilizer, whereas with the latter treatment, the incidence of cotton wilt was decreased from 33.3 per cent to 13.3 per cent and the decrease in the incidence of wilt on the manure plots was only to 18.9 per cent.

"Rust," or potash hunger, evidenced by early maturity, reddening or browning of foliage, early defoliation, small, poorly matured top bolls and lowered yields, was present in all unfertilized plots and in all fertilized plots from which potash was omitted. The series fertilized with superphosphate alone seemed to show an actual intensification of potash hunger symptoms. In previous work, the same observation was made and in some cases

very heavy applications of nitrate of soda appeared to have a similar effect. There seems little doubt that heavy applications of non-potash-containing fertilizers may actually produce such an unbalanced condition in the cotton plant as to even increase the injury from "rust." If, as seems probable, the control of cotton wilt through the use of potash fertilizers is dependent on the elimination of "rust," the ineffectiveness of nitrate and phosphate either alone or in combination for the control of cotton wilt seems fully to be expected. From the point of view of cotton wilt and "rust" control, heavy applications of potash alone (144 pounds of muriate of potash or 480 pounds of 15 per cent kainit) seemed entirely effective, but apparently such a fertilizer did not provide a sufficient amount of other raw materials for the best growth of cotton.

Only one year's results from the "combined test" are available, but, since this experiment is a combination of two phases of the work upon which several years' work is already available, it is felt that useful conclusions may be drawn. The greatest incidence of wilt resulted when the variety Missdel 2 was used on non-fertilized plots, the average amount of cotton wilt being close to 33.3 per cent. In contrast to this situation, adjacent unfertilized checks of Rowden 2088 showed only 5.8 per cent of cotton wilt. This is in agreement with results secured with these two varieties in the "wilt variety test." As for the value of fertilizers for cotton wilt control, the more striking results were secured with the susceptible variety Missdel 2, the greatest reduction being from 33.3 per cent in the checks to about 12 per cent when 340 pounds of 20 per cent kainit was used. Other applications containing potash resulted in substantial decreases in the incidence of cotton wilt, except the application of 600 pounds of a 6-8-4 fertilizer which evidently did not provide sufficient potash to meet the situation. As in other work reported previously and in this bulletin, potash fertilizer alone gave substantial increases in yield but which were decidedly less than when a mixed fertilizer containing a like amount of potash was used.

In contrast to the plots of Missdel 2, the series planted to Rowden 2088 showed little cotton wilt even on unfertilized plots, the greatest amount of wilt in any of the check plots being 6.5 per cent compared to 33.3 for the Missdel 2 check plots. All fertilized plots, including the series fertilized with a 6-8-0 fertilizer, showed a reduction to approximately one-half the amount of wilt in the checks, but differences are not great enough to be a reliable measure of the effect of fertilizer on wilt control. However, field observations indicated very marked decreases in the amount of "rust" or potash hunger where potash fertilizers were used and from the

standpoint of yields, the benefits from the use of a complete fertilizer were outstanding.

From the standpoint of determining yield data, particularly in the varietal and strain tests where the soil lacked uniformity in degree of fertility, the numbers of replications were not ample to afford reliable comparisons. On the other hand the distribution of the wilt infestation in this soil was sufficiently even to afford reliable wilt-percentage determinations. It would not be amiss, however, to point out that, even though such extremely resistant varieties of cotton as Dixie-Triumph, Dixie 14, Miller, and the various resistant Arkansas Rowden strains have not always shown consistently high yields in the wilt test, they have constantly ranked high in production in the general varietal tests conducted at the Cotton Branch Experiment Station. Trice 304, Half and Half, and the various strains and derivatives of Delfos, which are excellent yielders when cotton wilt is absent, show very definite reductions in yield when seriously affected with cotton wilt. It is further pointed out that sufficient amounts of potash fertilizers applied alone to control "rust", or potash hunger, have also given as high a degree of cotton wilt control as the same amount of potash in a mixed fertilizer, but that in many cases at least the greatest yield increases have followed use of relatively high amounts of potash in a mixed fertilizer. Although more evidence is needed concerning the value of a program of cotton wilt and "rust" control involving the use of a highly wilt resistant variety and the liberal use of a balanced fertilizer containing a relatively large proportion of potash, all the evidence so far secured points to the great value of such a program.

Summary

Further studies supplementing previously published results confirm the value of most of the wilt resistant varieties previously found desirable under Arkansas conditions and indicate further the value of the newer wilt-resistant varieties developed in other parts of the cotton-growing area.

Data are presented concerning the various properties of many of the newer Arkansas strains, especially the newer Arkansas Rowden strains.

Many of the promising newer strains, such as those developed from Delfos, the tested Stoneville strains, certain strains of Acala, and Qualla are shown to be highly susceptible to cotton wilt under the conditions of this experiment, and are clearly undesirable when cotton wilt is severe.

Further studies on the relation of fertilizers to the control of cotton wilt indicate that if sufficient amounts of potash, either in the form of muriate of potash or kainit are used to control "rust,"

or potash hunger, the incidence of cotton wilt is greatly reduced. When potash is applied alone, however, yields of seed cotton are often markedly inferior to those when the same amount of potash is used in a complete fertilizer.

Nitrate of soda and superphosphate alone and in combination are ineffective for the control of cotton wilt and "rust." In some cases such applications resulted in such an unbalanced condition in the cotton plant that it actually increased the amount of damage from "rust" and possibly from cotton wilt.

Stable manure applied at the rate of 10 tons per acre gave yield increases comparable to those secured by the application of 600 pounds of a 6-8-6 fertilizer and gave good control of "rust". However, it was only slightly effective in cotton wilt control.

Although further work is needed, indications are that the best program for the control of cotton wilt and "rust" will result from the use of a suitable wilt-resistant variety and the application of a mixed fertilizer containing sufficient potash to eliminate "rust," or potash hunger.

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